Decision Support Systems (DSS)

Question?

- Consider the ABC Company. The data for output produced and inputs consumed for a particular time period are given below.
- Output = $1000
- Human input = 300
- Material input = 200
- Capital input = 300
- Energy input = 100
- Other expense input = 50
- It is assumed that these values are in constant dollars with respect to a base period. Calculate total and partial productivities.

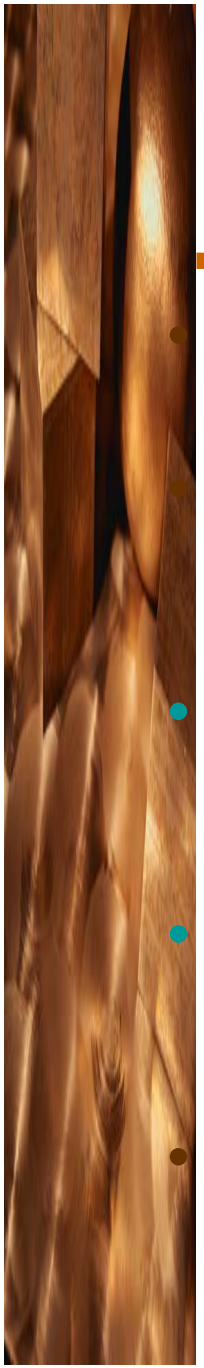
Decision Support System?

- A Decision Support System (DSS) is an interactive computer-based system or subsystem intended to help decision makers use communications technologies, data, documents, knowledge and/or models to identify and solve problems, complete decision process tasks, and make decisions.
- Decision Support System is a general term for any computer application that enhances a person or group's ability to make decisions.
- Also, Decision Support Systems refers to an academic field of research that involves designing and studying Decision Support Systems in their context of use.

DSS ?

DSS

- requires hardware
- requires software
- requires human elements(designer and end-user)
- is designed to support decision making.
- should help decision makers at all levels.
- emphasizes semi-structured and unstructured problems.



A brief history of DSS

- Academic Researchers from many disciplines has been studying DSS for approximately 40 years.
- According to Keen and Scott Morton (1978), the concept of decision support has evolved from two main areas of research:
- 1-The theoretical studies of organizational decision making done at the Carnegie Institute of Technology during the late 1950s and early 1960s,
- 2- The technical work on interactive computer systems, mainly carried out at the Massachusetts Institute of Technology in the 1960s.
- It is considered that the concept of DSS became an area of research of its own in the middle of the 1970s.

A brief history of DSS

- In the middle and late 1980s, Enterprise Information Systems (EIS), group decision support systems (GDSS), and organizational decision support systems (ODSS) evolved from the single user and model-oriented DSS.
- Beginning in about 1990, data warehousing and on-line analytical processing (OLAP) began broadening the realm of DSS.
- As the turn of the millennium approached, new Web-based analytical applications were introduced.

Why DSS?

- Increasing complexity of decisions
  - Technology
  - Information:
    - "Data, data everywhere, and not the time to think!"
  - Number and complexity of options
  - Pace of change
- Increasing availability of computerized support
  - Inexpensive high-powered computing
  - Better software
  - More efficient software development process
- Increasing usability of computers

Perceived benefits

- **decision quality**
- **improved communication**
- **cost reduction**
- **increased productivity**
- **time savings**
- **improved customer and employee satisfaction**

Approaches to the design and construction of DSS

- Studies on DSS development conducted during the last 40 years have identified more than 30 different approaches to the design and construction of decision support methods and systems.
- None of these approaches predominate and the various DSS development processes usually remain very distinct and project-specific.

A summary of commercial DSS system

- A summary of commercial DSS system show the following types of DSS:
  - **File Drawer Systems**, that provide access to the data items.
  - **Data Analysis systems**, that support manipulation of data by computerized tools for analysis.
  - **Analysis Information systems,** that provide access to a series of decision oriented databases and small models.(Ex. OLAP)
  - **Accounting and financial models,** that calculates the consequences of possible actions.(EX. Excel)
  - **Representational models**, that estimates the consequences of actions based on simulation models.
  - **Optimization models**, that provide guidelines for action by generating an optimal solution.(Ex. Linear programming)

DSS is A Multidiscipline Study

- It is clear that DSS belong to an environment with multidisciplinary foundations, including (but not exclusively):
  - Database research,
  - Artificial intelligence,
  - Human-computer interaction,
  - Modeling & Simulation methods,
  - Software engineering, and
  - Telecommunications.

What do Decision Support Systems Offer?

- Quick computations at a lower cost
- Group collaboration and communication
- Increased productivity
- Ready access to information stored in multiple databases and data warehouse
- Ability to analyze multiple alternatives and apply risk management(perform complex simulation models and checking many possible scenarios)
- Enterprise resource management
- Tools to obtain and maintain competitive advantage(organizations must be able to frequently and rapidly change their mode of operations)

Cognitive Limits

- The human mind has limited processing and storage capabilities.
- Any single person is therefore limited in their decision making abilities.
- Collaboration with others allows for a wider range of possible answers, but will often be faced with communications problems.
- Computers improve the coordination of these activities.
- This knowledge sharing is enhanced through the use of GSS and EIS.

Management Support Systems

- The support of management tasks by the application of technologies
  - Sometimes called Decision Support Systems or Business Intelligence

Management Support Systems Tools(Technologies)

- Data Mining
- OLAP
- Data Warehouse
- DSS
- Business Analytics
- Business Intelligence
- CASE tools
- GSS
- EIS(Enterprise Information System)
- Management Science
- EIP(Enterprise Information Portal)
- ERM(Enterprise resource Manager)
- ERP (Enterprise resource Portal)
- CRM(Customer resource management)
- SCM(Supply-chain management)
- KMS(Knowledge management systems)
- KMP(knowledge management portals)
- ES(Expert systems)
- ANN(Artificial Neural Networks)
- E-commerce DSS

Figure 1.2 Decision Support Frameworks

Type of Decision	Type of Control: Operational Control	Type of Control: Managerial Control	Type of Control: Strategic Planning	Technology Support Needed
Structured	1 Accounts receivable, account payable, order entry	2 Budget analysis, short-term forecasting, personnel reports, make-or-buy	3 Financial management (investment), warehouse location, distribution systems	Management information system, management science models, transaction processing
Semistructured	4 Production scheduling, inventory control	5 Credit evaluation, budget preparation, plant layout, project scheduling, reward system design, inventory categorization	6 Building new plant, mergers and acquisitions, new product planning, compensation planning, quality assurance planning, HR policies, inventory planning	DSS, KMS, GSS, CRM, SCM
Unstructured	7 Selecting a cover for a magazine, buying software, approving loans help desk	8 Negotiating, recruiting an executive, buying hardware, lobbying	9 R & D planning, new technology development, social responsibility planning	GSS, KMS ES, neural networks
Technology Support Needed	Management information system, managment science	Management science, DSS, ES, EIS, SCM CRM, GSS, SCM	GSS, CRM EIS, ES, neural networks, KMS	

Decision Support Frameworks

	Type of Control		
Type of Decision:	**Operational Control**	**Managerial Control**	**Strategic Planning**
Structured (Programmed)	Accounts receivable, accounts payable, order entry	Budget analysis, short-term forecasting, personnel reports	Investments, warehouse locations, distribution centers
Semistructured	Production scheduling, inventory control	Credit evaluation, budget preparation, project scheduling, rewards systems	Mergers and acquisitions, new product planning, compensation, QA, HR policy planning
Unstructured (Unprogrammed)	Buying software, approving loans, help desk	Negotiations, recruitment, hardware purchasing	R&D planning, technology development, social responsibility plans

Technologies for Decision-Making Processes

Type of Decision	Technology Support Needed
Structured (Programmed)	MIS, Management Science Models, Transaction Processing
Semistructured	DSS, KMS, GSS
Unstructured (Unprogrammed)	GSS, KMS, ES, Neural networks

Technology Support Based on Anthony's Taxonomy

	Type of Control		
	Operational Control	**Managerial Control**	**Strategic Planning**
Technology Support Needed	MIS, Management Science	Management Science, DSS, ES, EIS, GSS	GSS, EIS, ES, neural networks, KMS

Types of decisions or problems

1- Structured problems are routine, and typically repetitive problems for which standard solution methods exist. The computer is often the basis for decision-making. (ex. Distribution centers)

2- Unstructured problems are fuzzy, complex problems for which there are no cut-and-dried solution methods. Human intuition is often the basis for decision-making. (ex. choosing a cover for a magazine).

3-Semi-structured problems are a combination structured and unstructured phases.(Computer and human based decision making).(ex. Production scheduling)

End

Management Science/Operations Research

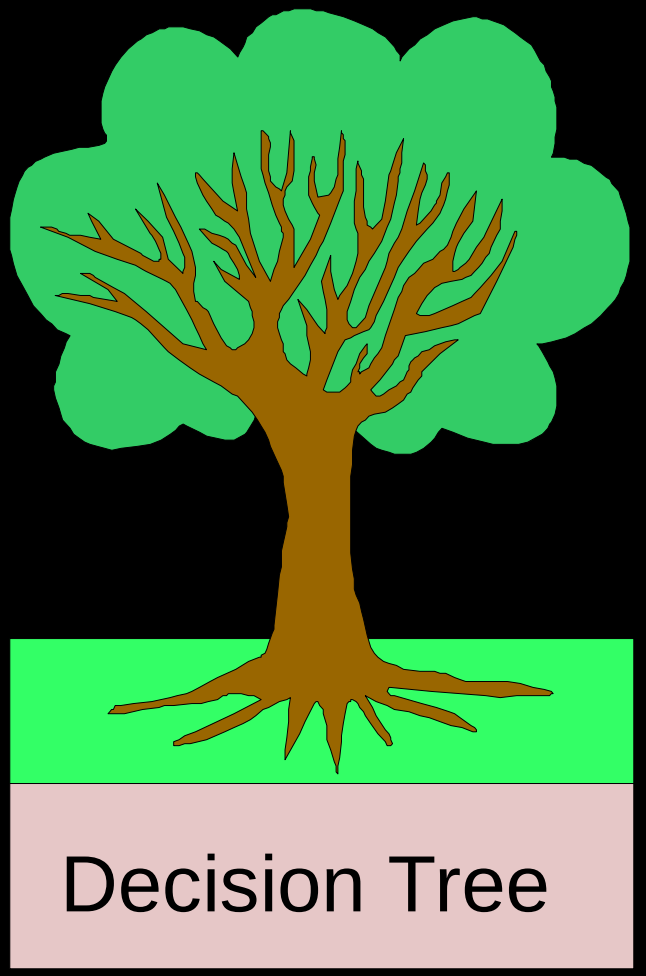
- Adopts systematic approach
  - Define problem
  - Classify the problem into standard category
  - Construct mathematical model
  - Evaluate alternative solutions
  - Select solution

  Examples for problems solved by this technology
  - Make or buy decision
  - Allocation of resources
  - Distribution problems

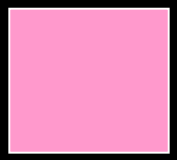
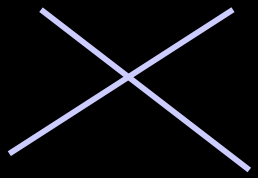
  Decision trees are used frequently in operations research.

What is a Decision Tree?

- A Visual Representation of Choices, Consequences, Probabilities, and Opportunities.
- A Way of Breaking Down Complicated Situations Down to Easier-to-Understand Scenarios.



Notation Used in Decision Trees

- A box  is used to show a choice that the manager has to make.
- A circle  is used to show that a probability outcome will occur.
- Lines  connect outcomes to their choice or probability outcome.

Mary's Factory

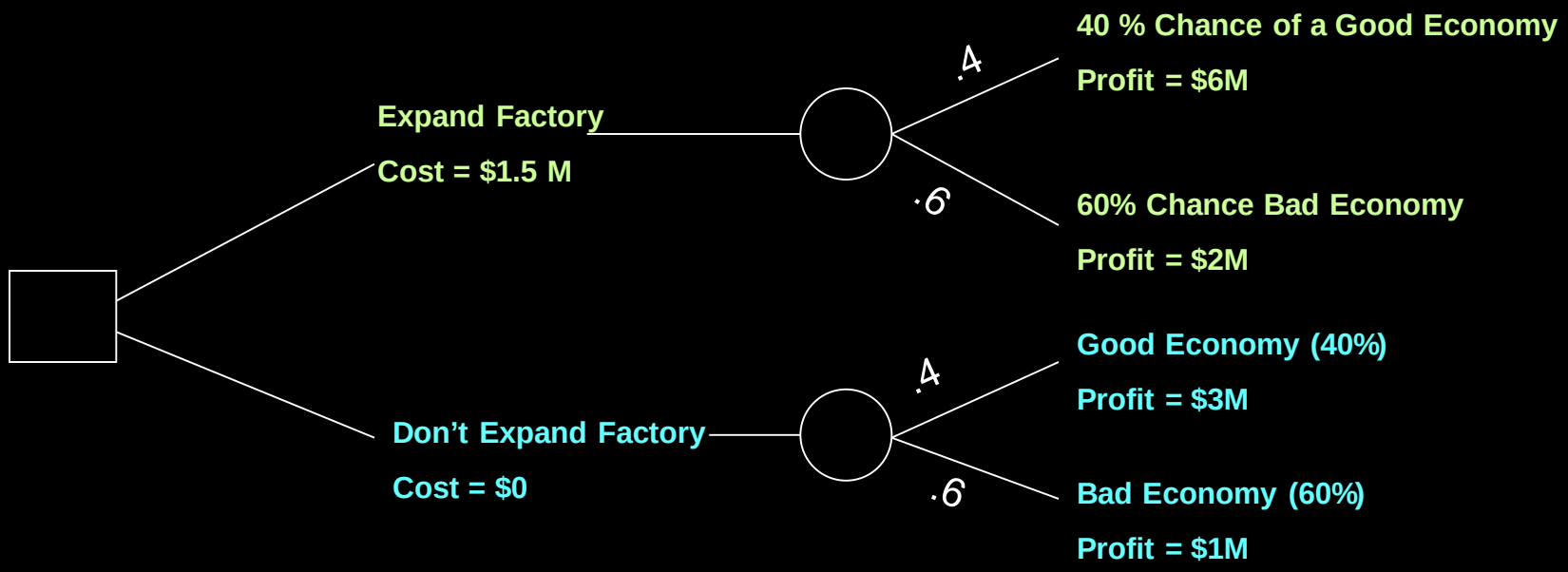
Mary is a manager of a gadget factory. Her factory has been quite successful the past three years. She is wondering whether or not it is a good idea to expand her factory this year. The cost to expand her factory is $1.5M. If she does nothing and the economy stays good and people continue to buy lots of gadgets she expects $3M in revenue; while only $1M if the economy is bad.

If she expands the factory, she expects to receive $6M if economy is good and $2M if economy is bad.

She also assumes that there is a 40% chance of a good economy and a 60% chance of a bad economy.

(a) Draw a Decision Tree showing these choices.

Decision Tree Example



$NPV_{Expand} = (.4(6) + .6(2)) – 1.5 = \$2.1M$

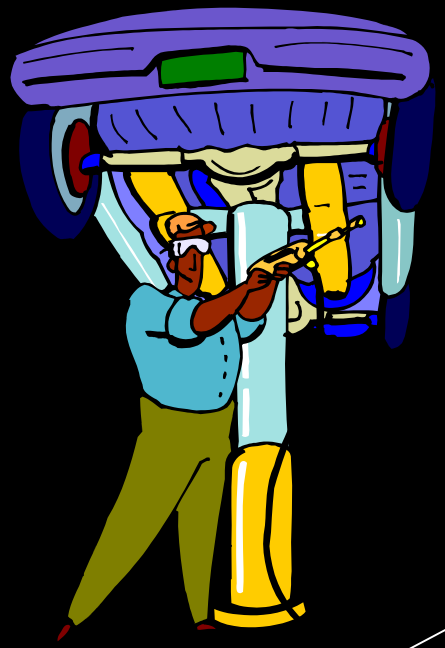
$NPV_{No\ Expand} = .4(3) + .6(1) = \$1.8M$

$2.1 > 1.8, therefore she should expand the factory

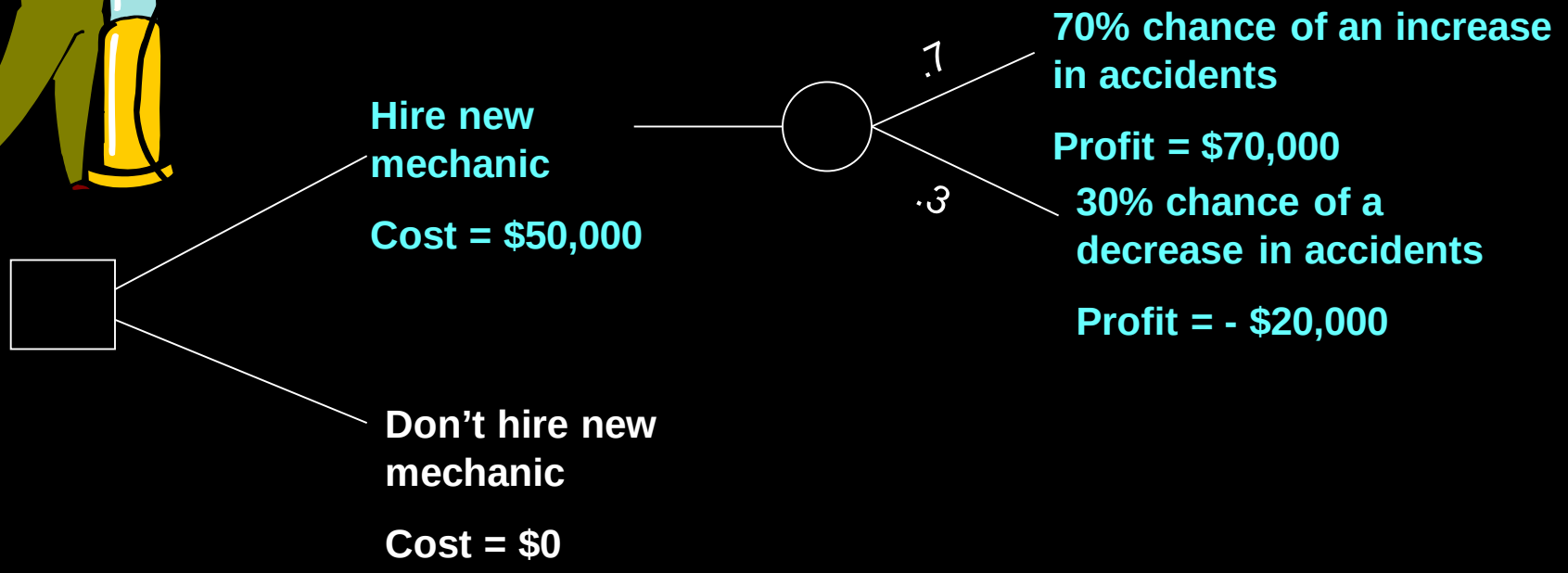
Example 2 – Joe's Garage

Joe's garage is considering hiring another mechanic. The mechanic would cost them an additional $50,000 / year in salary and benefits. If there are a lot of accidents in Providence this year, they anticipate making an additional $70,000 in net revenue. If there are not a lot of accidents, they could lose $20,000 off of last year's total net revenues. Because of all the ice on the roads, Joe thinks that there will be a 70% chance of "a lot of accidents" and a 30% chance of "fewer accidents". Assume if he doesn't expand he will have the same revenue as last year.

Draw a decision tree for Joe and tell him what he should do.



Example 2 - Answer



- Estimated value of "Hire Mechanic" =
NPV =.7(70,000) + .3(- $20,000) - $50,000 = - $7,000
- Therefore he should not hire the mechanic

Knowledge Management Systems

- Knowledge is anticipated from information.
- Knowledge is then organized and stored in a repository for use by an organization.
- Can be used to solve similar or identical problems in the future.

Expert Systems

- Attempts to mimic human experts' problem solving
- Is a problem solving computer package that apply reasoning methodologies in a specific domain.

- Examples include:
  - Artificial Neural Networks (neural computing)
  - Genetic Algorithms
  - Fuzzy Logic
  - Artificial Intelligence Systems

Hybrid Support Systems

- Used when there are no standard tools(systems).
- Integration of different computer system tools to resolve problems
- Tools perform different tasks, but support each other
- Together, produce more sophisticated answers
- Work together to produce smarter answers

Definitions

- **DBMS** - System for storing and retrieving data and processing queries
- **Data warehouse** - Consolidated database, usually gathered from multiple primary information sources(TPS), organized and optimized for reporting and analysis
- **MIS** - System to provide managers with summaries of decision-relevant information
- **Expert system** - computerized system that exhibits expert-like behavior in a given problem domain
- **DSS** - provide automated support for any or all aspects of the decision making process
- **EIS** (Executive information system) - A kind of DSS specialized to the needs of top executives

Management Information Systems

- MIS
- Produces information products that support many of the day-to-day decision-making needs of managers and business professionals.
- Produces different types of reports.
- Support more structured decisions

MIS Reporting Alternatives

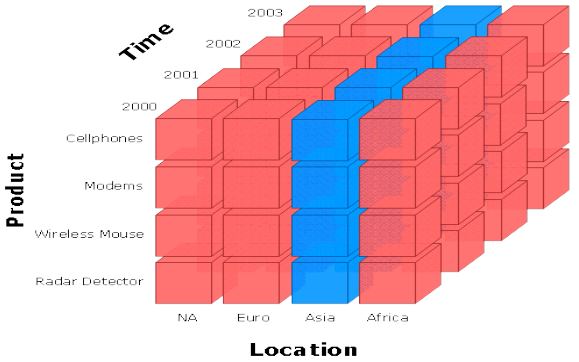
- Periodic Scheduled Reports
  - Prespecified format on a regular basis
- Exception Reports
  - Reports about exceptional conditions
  - May be produced regularly or when exception occurs
- Demand Reports and Responses
  - Information available when demanded
- Push Reports
  - Push reporting delivers documents with minimal effort on the recipients' part. Files may be delivered as attachments to e-mail messages or via a Web-based report channel.
  - a push report is sent to users(specific information consumers) according to a schedule

Online Analytical Processing

- OLAP
  - OLAP is computer processing that enables a manager to easily and selectively extract ,view and analysis of data from different points of view.
  - For example, a manager can request that data be analyzed to display a spreadsheet showing all of a company's beach ball products sold in Florida in the month of July, compare revenue figures with those for the same products in September, and then see a comparison of other product sales in Florida in the same time period.
  - To facilitate this kind of analysis, OLAP data is stored in a multidimensional database(OLAP cube).

OLAP Analytical Operations

- Consolidation (roll-up)
  - Aggregation of data from different resources in one or more dimensions.
- Drill-down
  - Drilling down through a database involves accessing information by starting with a general category and moving through the hierarchy: from category to file/table to record to field.
  - Slicing and Dicing
  - Ability to look at the database from different viewpoints



Data Mining

- Main purpose is to provide decision support to managers and business professionals through knowledge discovery
- Analyzes vast store of historical business data
- Tries to discover patterns and correlations hidden in the data that can help a company improve its business performance
- Uses regression, decision tree, neural network, cluster analysis(clustering), or market basket analysis.

Executive Information Systems

- EIS
  - Provide top executives with immediate and easy access to information
  - EIS emphasizes graphical displays and easy-to-use user interfaces.
  - They offer strong reporting and drill-down capabilities
  - help top-level executives analyze, compare, and highlight trends in important variables so that they can monitor performance and identify opportunities and problems in their organizations.

Enterprise Information Systems(EIS)

- Evolved from Executive Information Systems combined with Web technologies. So used in multi-national companies.
- EIPs view information across entire organization
- Provide rapid access to detailed information through drill-down.
- Provide user-friendly interfaces through portals.
- Identifies opportunities and threats
- Filter, compress, and track critical data and information.

How DSS is used for seeking a solution

- What-if Analysis
  - End user makes changes to variables, or relationships among variables, and observes the resulting changes in the values of other variables
- Sensitivity Analysis
  - Value of only one variable is changed repeatedly and the resulting changes in other variables are observed

Using DSS

- Goal-Seeking
  - Set a target value for a variable and then repeatedly change other variables until the target value is achieved
- Optimization
  - Goal is to find the optimum value for one or more target variables given certain constraints
  - One or more other variables are changed repeatedly until the best values for the target variables are discovered

Question?

1- Explain the following terms :

- OLAP
- Data warehouse
- MIS
- Operations research
- Data Mining

2- How DSS tools are used for seeking a solution or making a decision?

Team Presentation

- Select one of the subjects below and make a team of 3 student, design a presentation scenario and present the subject in class. All 3 student should participate in the presentation.

1. Regression and Statistical Forecasting with Excel.
2. Intelligent Decision Support System
3. Linear programming based case study with Excel.
4. Marketing Decision Models
5. Decision-Making in Engineering Design.
6. SAP and Dash boards.
7. Expert systems.

Note that your presentation should include examples related to your presentation topic.